

Dungeness Water Watch

Fish Out of Water, Part 2: What is an IFIM?

The December, 2011 issue of the Dungeness Water Watch described the state of salmon in the Dungeness River and other eastern Clallam County streams. With four species of salmon listed as threatened under the Federal Endangered Species Act, adequate stream flows are an essential factor in salmon recovery. To answer the question, "How much water do the Dungeness salmon need?" fisheries scientists from the U.S. Fish and Wildlife Service (USFWS) prepared a study of the relationship between flows and fish habitat in 1988-89 using the "Instream Flow Incremental Methodology" or IFIM. This edition of the Water Watch is about the IFIM method and how it is used in setting instream flows for regulatory purposes. (See next column)

The steps in the IFIM study for the Dungeness River are outlined below

1. Select study sites that represent different sections of the river: Scientists select sections of the river that represent different stream channel and habitat characteristics. In the Dungeness IFIM study, two study sites were selected. The lower study site was located between Woodcock Road and the Schoolhouse Bridge, where the river has generally been confined into a single channel by levees on both sides. The upper study site was located between Railroad Bridge Park and Old Olympic Highway, where there are no levees and the river has multiple braids and side channels. Figure 1 illustrates the different shape of the river channel at the two sites.

2. Measure stream flow and fish habitat: At the study sites, the scientists take detailed measurements of the width, depth, water velocity, temperature, and channel characteristics (type of gravel, vegetation, etc.). Measurements are taken at different times of the year under both high flow and low flow conditions.

What constitutes "enough water" for fish depends on many factors that affect fish survival. Fish need enough water to keep water temperatures cool. They need enough flow to allow them to move upstream and down, and to keep water flowing over spawning areas when eggs are in the gravel. They also need water in side channels, where small fish take refuge, and where there is overhanging vegetation and insects that provide food. Fish also need enough water to be able to get out of the stream center where water is fast (requiring them to swim hard), and deep pools to take cover from predators. These requirements are different for different species of fish and different life stages (eggs, juvenile salmon, migrating adult salmon, and spawners), and vary by season. Studies to establish a set of recommended numbers for instream flows are thus very complex.

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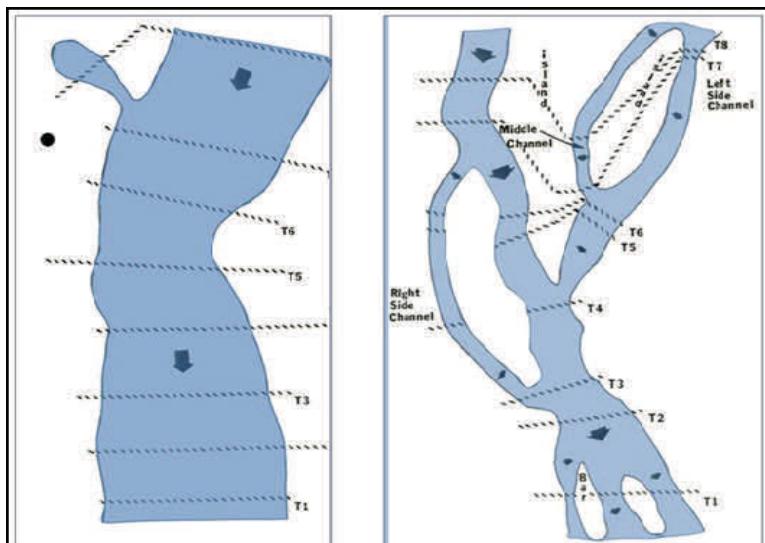


Figure 1: Difference in channel shape between the lower (left) and upper (right) study sites in the Dungeness IFIM study. The dotted lines show study transects where measurements were taken.

3. Run the PHABSIM model: The measurements are fed into a group of computer models collectively known as a PHABSIM (Physical HABitat SIMulation). The result is a series of graphs that show the incremental change in "usable habitat area" as stream flows increase or decrease. The model output shows results for different salmon species and different uses by fish. Fish biologists also verify the model results by snorkeling the river and recording the location, species, water depth, and velocity where each fish was found.

Figure 2: Usable area of habitat per stream flow (discharge) for Chinook salmon spawning at the upper study site, river mile 4.2

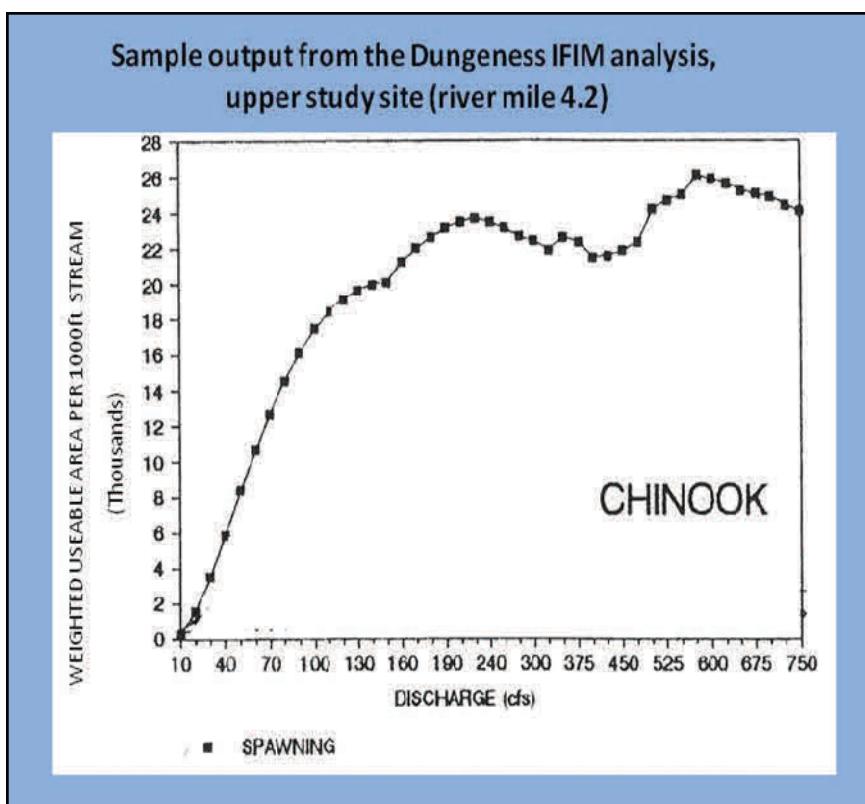


Figure 2 is an example of the output from the Dungeness PHAB-SIM model. The results display the area of usable habitat (for spawning) per amount of stream flow (discharge) for Chinook at the upper study site. The graph shows that the amount of usable habitat area for Chinook spawning goes up rapidly at first as flow increases. This is a logical result—the fish need water in the river channel in order to use it for habitat. As flow increases, the amount of usable habitat area increases, until approximately 180–200 cubic feet per second (cfs). As flow increases from there, more water does not produce more usable habitat area until the flow reaches a level of about 500 cfs. At that point there are additional side channels receiving water, thus increasing the habitat area.

The output from the model includes dozens of graphs that are similar to the results in Figure 2. Every species has separate results and the information is broken down further depending on whether the fish of a given species are still in the egg stage, juveniles, migrating adults, or spawners.

Analyzing the data requires local knowledge of salmon species and age groups at different times of the year. After the model results were available from the Dungeness study, the U.S. Fish and Wildlife Service reviewed the information with biologists who had specific knowledge of the Dungeness from the National Marine Fisheries Service, the Washington Department of Ecology (Ecology), the Washington Departments of Fisheries and Wildlife (separate agencies at that time), and the Jamestown S’Klallam Tribe. The biologist group was asked to recommend an instream flow level for each month, for regulatory purposes.

Why are instream flow numbers important to fish and wildlife habitat?

Watch the video by Dr. Hal Beecher, Department of Fish and Wildlife

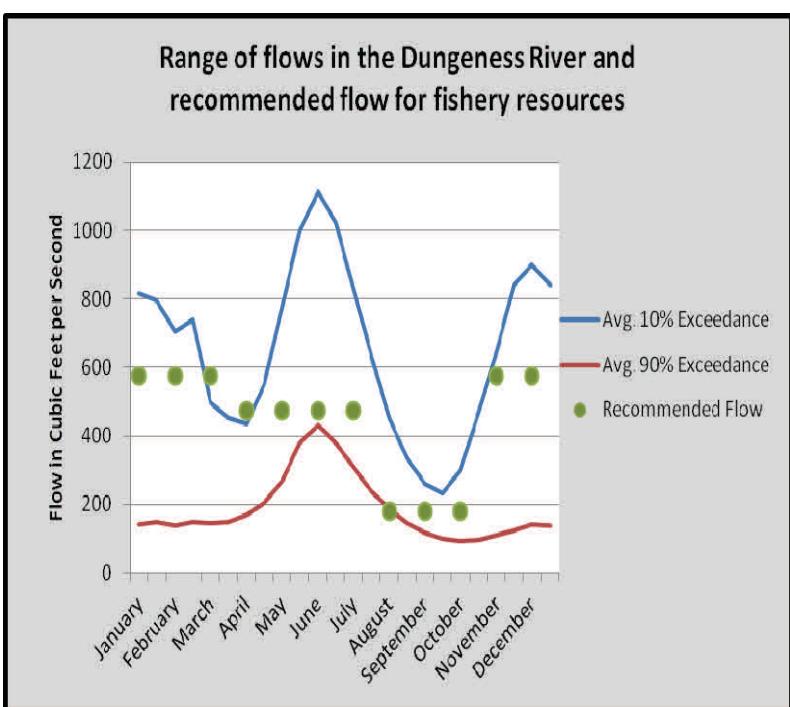
<http://www.youtube.com/watch?v=Lcijlfq3QA>

4. Recommend instream flows, month by month: The recommendations for instream flows from the IFIM study are based on the amount of fish habitat per flow level, along with seasonal fish use, life-stage, and historical flow records. In developing flow recommendations, higher ranking is given to instream flow levels that support priority species, such as salmon runs that are depleted. For example, priority species in the Dungeness IFIM analysis for September were Chinook salmon, pink salmon, chum salmon, and steelhead. The results at the upper study site were given more weight in the analysis because the site was representative of more stream miles. Stream flows needed for spawning are often given a higher priority than flows for other fish life-stages, but all the life-stages and species exist simultaneously and are blended together to create a monthly recommendation at a level that is protective of fish use.

Comparing recommended instream-flows for fish to recorded stream flows

Many people have asked why the recommended instream flows for fish that resulted from the Dungeness IFIM study are higher than the average monthly stream flows that have been recorded at the USGS gage (or in some months, lower). The recommended flows are based on model results that predict usable habitat area rather than the amount of water flowing in the stream. Additionally, stream flows fluctuate from day to day and year to year (even hour to hour at times), and looking at an “average” flow does not provide a full picture of how much flows can vary. Figure 3 shows a range of flows in the Dungeness River and the recommended flow for fish from the IFIM study. Stream flows in the Dungeness River at the USGS gage generally fall between the blue line and the red line, except for very high and very low flows. The gage is located upstream of irrigation diversions.

Figure 3: Flows in the Dungeness River (at 10% and 90% exceedance)¹ and recommended flow for fishery resources.



In Figure 3, the average daily flows are between the blue line and the red line for all but the highest 10% and lowest 10% of flows on record (USGS gage 1924-2008). The green dots show the recommended instream flow for fisheries resources for each month, based on the IFIM analysis (U.S. Fish & Wildlife Service, 1993).

The Dungeness IFIM study was completed and analyzed between 1988 and 1993. Small streams in eastern Clallam and Jefferson Counties were also evaluated by the USFWS in the early 1990's using a less intensive method to develop instream flow recommendations, known as the "toe-width" method. A detailed discussion of the IFIM study and more on these questions can be found at: http://www.ecy.wa.gov/programs/wr/instream-flows/01302012_dungeness_ifs_qna.html

Ecology was asked in early 2012 whether it is appropriate to repeat the IFIM study because of the length of time since it was completed, or to review the original research methods and calculations in detail. After a review of these questions, Ecology issued a letter stating that a new study or detailed review of the original research is not necessary for several reasons—many sections of the river are not substantially different from the original study sites, and, although modeling calculations can be done faster due to technological advances in computers, the basic field techniques and data for IFIM are the same. Fisheries experts in IFIM modeling have indicated a new study would likely point toward similar or higher instream flow recommendations for fish. As noted in their summary report, the Local Leaders Work Group has a difference of opinion on the necessity and potential value of repeating an IFIM study.

¹ An **exceedance flow** is defined as the flow that is equaled or exceeded a certain percentage of time. A 10% exceedance flow is high, and indicates that flows are at or higher than that level for only 10% of the days on record. A 90% exceedance flow means that the flows are at or higher than that level for 90% of the time.

This issue is the last of six in a series produced under the direction of the LLWG. The monthly Dungeness Water Watch will continue, however, as a Washington Department of Ecology publication. To get the Dungeness newsletters please subscribe to the Dungeness listserv at: <http://listserv.wa.gov/cgi-bin/wa?A0=DUNGENESS-WATER-MANAGEMENT> and follow the link to "join" the list.

How are IFIM flow studies used in water management rule making?

Washington State law requires Ecology to set instream flow levels in Washington rivers to protect fish and other instream values for the long term future. Instream flows are established by rule so that Ecology can consider future water needs of people, and determine when there is sufficient water available to allocate to new uses, subject to senior water rights. IFIM studies have been used to set instream flows for fishery resources in many water management rules in Washington watersheds, and are recognized as a scientifically valid method by the Washington State Supreme Court.² Instream flows are not set at the level of recorded low stream flows—they must be high enough to protect existing resources, and allow for the needs of different fish species at different seasons of the year. If fish do not have the potential opportunity for good flow years, they will not be able to sustain their numbers in the long term.

Once an instream flow is set in rule, it does not ensure that the recommended amount of flow will be present in the river, or even a lower target flow for stream restoration. Flows may simply not be available in the river due to natural fluctuations in snowpack and runoff. Moreover, existing senior water rights take precedence under state law, regardless of the instream flow number that has been set. The rule will not affect the ability of irrigation districts and companies with senior water rights, existing well users, or others with existing water rights to use their water rights.

² In 1993, the Court found that using IFIM "optimum" flow numbers was the correct method to set an instream flow under RCW 90.54. (State of Washington, Department of Ecology, Department of Fisheries and Department of Wildlife, Respondents, v. PUD No. 1 of Jefferson County and City of Tacoma, Department of Public Utilities. 121 Wn.2d 179, 849 P.2d 646 (1993)).

The Local Leaders Water Management Work Group concluded regular meetings in early March by summarizing its accomplishments and recommendations in a report. The LLWG summary report describes both concurring and diverging positions on various topics, with agreement that water management in the Dungeness is a perpetual work in progress. The report can be found at: www.clallam.net/HHS/EnvironmentalHealth/committee_LLGW.html